What is claimed is:

CLAIMS

1. A method for triggering haptic sensations from sound features detected in sound output from a computer, said haptic sensations able to be delivered to a user of a haptic feedback device in communication with said computer, the method comprising:

storing a portion of sound data that is output to a user as audio from an application program running on said computer, wherein said portion of sound data is stored in a memory buffer of said computer;

analyzing said portion of sound data using intelligent heuristics to extract at least one sound feature from said portion of sound data; and

triggering the execution of at least one haptic effect based on said at least one sound feature, wherein said at least one haptic effect is commanded to said haptic feedback device approximately correlated to said output of said portion of sound data to said user as audio, said haptic effect causing a haptic sensation to be output to said user.

2. A method as recited in claim 1 wherein said analyzing said portion of said sound data includes processing said sound data into a plurality of different frequency ranges and extracting said sound feature from each of said frequency ranges.

3. A method as recited in claim 2 wherein a haptic effect is associated with each of said frequency ranges if said sound feature is present in said frequency range.

4. A method as recited in claim 2 wherein said processing said sound data into a plurality of different frequency ranges includes applying a plurality of filters to said portion of sound data.

5. A method as recited in claim 4 wherein at least one low-pass filter, at least one high-pass filter, and at least one bandpass filter is applied to said portion of sound data to provide at least three frequency ranges.

6. A method as recited in claim 2 wherein said processing said sound data into a plurality of different frequency ranges includes using a fast Fourier transform (FFT).

7. A method as recited in claim 6 wherein a number of outputs from said fast Fourier transform are grouped to provide each of said frequency ranges.

8. A method as recited in claim 4 wherein each of said frequency ranges is associated with a different haptic sensation.

9. A method as recited in claim 8 wherein each of said frequency ranges is associated with a periodic haptic sensation having a different frequency.

10. A method as recited in claim 1 wherein said at least one haptic effect triggered by said at least one sound feature was previously mapped to said at least one sound feature.

11. A method for providing haptic effects based on sound data played by a computer, said haptic effects able to be output as haptic sensations to a user of a haptic feedback device in communication with said computer, the method comprising:

storing a portion of said sound data that is output from an application program running on said computer, wherein said portion of sound data is stored in a memory buffer of said computer;

analyzing said portion of sound data using intelligent heuristics to extract at least one high-level sound feature from said portion of sound data, wherein said at least one high-level sound feature in said portion of sound data has been associated with at least one high-level haptic effect; and

commanding said associated at least one haptic effect to be output approximately when said associated sound feature is played by said application program.

12. A method as recited in claim 11 wherein said analyzing said portion of said sound data includes processing said sound data into a plurality of different frequency ranges and extracting said sound feature from each of said frequency ranges.

13. A method as recited in claim 12 wherein a haptic effect is associated with each of said frequency ranges having said sound feature.

14. A method as recited in claim 12 wherein said processing said sound data into a plurality of different frequency ranges includes applying a plurality of filters to said portion of sound data.

15. A method as recited in claim 12 wherein said processing said sound data into a plurality of different frequency ranges includes using a fast Fourier transform (FFT).

16. A method as recited in claim 15 wherein a number of outputs from said fast Fourier transform are grouped to provide each of said frequency ranges.

17. A method as recited in claim 13 wherein each of said frequency ranges is associated with a different haptic effect.

18. A method as recited in claim 17 wherein each of said frequency ranges is associated with a periodic haptic effect having a different frequency.

19. A method as recited in claim 11 wherein said commanded at least one haptic effect is output as a haptic sensation to said user by said haptic feedback device.

20. A method as recited in claim 11 wherein said commanded haptic effect is not output to said user but is stored in memory of said computer as a created haptic effect.

21. A computer readable medium including program instructions for providing haptic sensations correlated with sound output from a computer to a user of a haptic feedback device in communication with said computer, the program instructions performing steps comprising:

storing a portion of sound data that is to be output to a user as audio from an application program running on said computer, wherein said sound data is stored in a memory buffer of said computer;

analyzing said portion of sound data to extract at least one sound feature from said portion of sound data; and

assigning at least one haptic effect to said at least one sound feature, wherein said at least one haptic effect is commanded to said haptic feedback device approximately during said output of said portion of said sound to said user as audio, said haptic effect causing a haptic sensation to be output to said user.

22. A computer readable medium as recited in claim 21 wherein said analyzing said portion of said sound data includes processing said sound data into a plurality of different frequency ranges and extracting said sound feature from each of said frequency ranges.

23. A computer readable medium as recited in claim 22 wherein a haptic effect is associated with each of said frequency ranges if said sound feature is present in said frequency range.

24. A computer readable medium as recited in claim 22 wherein said processing said sound data into a plurality of different frequency ranges includes applying a plurality of filters to said portion of sound data.

25. A computer readable medium as recited in claim 22 wherein said processing said sound data into a plurality of different frequency ranges includes using a fast Fourier transform (FFT).

26. A computer readable medium as recited in claim 24 wherein each of said frequency ranges is associated with a different haptic sensation.

27. A computer readable medium as recited in claim 21 wherein said at least one haptic effect commanded to said haptic feedback device was previously mapped to said at least one sound feature.

28. An apparatus for triggering haptic sensations from sound features detected in sound output from a computer, said haptic sensations able to be delivered to a user of a haptic feedback device in communication with said computer, the apparatus comprising:

means for storing a portion of sound data that is output to a user as audio from an application program running on said computer, wherein said portion of sound data is stored in a memory buffer of said computer;

means for analyzing said portion of sound data using intelligent heuristics to extract at least one sound feature from said portion of sound data; and

means for triggering the execution of at least one haptic effect based on said at least one sound feature, wherein said at least one haptic effect is commanded to said haptic feedback device approximately correlated to said output of said portion of sound data to said user as audio, said haptic effect causing a haptic sensation to be output to said user.